ATOTP0104US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Nayan H. Joshi et al	:	Group Art Unit: 1762
Application No.: 10/606,460	:	Examiner: Katherine A. Bareford
Filed: 26 June 2003	:	Confirmation No. 3492

For: AQUEOUS ACIDIC IMMERSION PLATING SOLUTIONS AND METHODS FOR PLATING ON ALUMINUM AND ALUMINUM ALLOYS

DECLARATION UNDER 37 CFR 1.132 OF NAYAN H. JOSHI

VIA EFS
M/S RCE
Commissioner for Patents
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Sir:

I, Nayan H. Joshi, declare and say as follows:

(1) I am a co-inventor of U.S. Application No. 10/606,460 ("the present application"). At present, I am General Metals Finishing (GMF) R&D Manager at Atotech U.S.A., a subsidiary of the assignee of the present application. I hold a M.S. degree in inorganic chemistry, awarded by Saurashtra University (India) in 1975, and Ph.D. degree in electrochemistry-metallic corrosion, awarded by Gujarat University (India) in 1980. Following these degrees, I worked in several institutions and

companies in India, until coming to the U.S. in 1984. I began working at M&T Chemicals in 1988, which was subsequently acquired by Atotech in 1992. I have been employed by Atotech U.S.A. since. Attached hereto as Exhibit A is a list of my publications and patents. Based on these facts, I consider myself, and believe my colleagues consider me to be a person of skill in the art of metal finishing generally, including the immersion plating art relevant to the present application.

(2) The present application includes claims drawn to an acidic immersion metal deposition process for depositing a zinc alloy protective coating on aluminum or aluminum based alloy substrates. The process forms a thin protective layer which is intended and used to protect the aluminum or aluminum alloy substrate from formation of an oxide on the surface, which otherwise would occur very quickly. The process is not intended to provide a final finish, but is intended to protect the surface until a subsequently applied, much thicker layer is deposited on the substrate by electroless plating or by electroplating. The process is neither intended to nor is able to deposit a thick metal deposit. The present invention provides an alternative to previously known alkaline zincate treatments, which avoids the necessity of hard complexing agents including cyanide ions and makes pre-plate treatment for aluminum friendlier to the environment.

(3) As is well known in the metal finishing arts, immersion plating, which is also known as chemical plating, proceeds by replacing surfacial atoms of the substrate with atoms of a more-noble metal from the immersion plating bath, in an oxidation-reduction reaction, whereby the substrate metal atoms, here aluminum, are dissolved and oxidized, and the nickel and zinc atoms in the immersion plating bath are reduced and deposited on the surface of the aluminum or aluminum alloy substrate. The more-noble nickel and zinc atoms replace the less-noble aluminum atoms. The reaction

proceeds only until there are no more aluminum atoms available on the surface, that is, until the surface is completely coated with a layer of nickel and zinc atoms. The layer is necessarily very thin, since once access to the underlying aluminum atoms has been blocked by even a single-atom-thick layer of the overlying immersion-plated metal atoms, the reaction cannot proceed further. The coating thickness is self-limiting since the reaction cannot proceed further. For this reason, an immersion-plated surface is not used as a final finish.

(4) The disclosed and claimed inhibitors in the immersion plating composition are present to control the rate of dissolution of aluminum and the relative rates of deposition of zinc and nickel. In the absence of the inhibitor, the replacement reaction would proceed quite rapidly to deposit a thick spongy immersion deposit, which is not suitable for subsequent plating processes. The inhibitor of the present invention provides needed control on the rate of deposition. As the process does not use electric current, the inhibitor/s in the present invention doesn't function like plating additives such as brighteners and levelers, used in electroplating.

(5) Additives such as brighteners and levelers are used in electroplating processes to achieve the desired brightness and leveling of the plated metal. A brightener is generally a positively charged molecule, such as the quaternary ammonium brighteners disclosed by Eckles, U.S. Patent No. 5,405,523, and this is attracted to the cathode along with the positively charged metal ions to be electroplated. At the cathode the brightener performs its function and causes the electrodeposited metal atoms to form a more reflective, brighter surface.

(6) There is no reason that a person of ordinary skill in the art would add a brightener to an immersion plating solution intended for use as a replacement for the

alkaline zincate processes of the prior art. As discussed above, the immersion plating process deposits only a very thin layer, i.e., the protective layer mentioned in the claims of the present application. The immersion-plated coating is intended to be over-coated with another metal layer deposited by a process such as electroless plating or electroplating, in which the thickness of the deposited metal layer is not limited as is the immersion-plated layer. Because of the very thinness of the immersion-plated layer, a brightener is not only not needed, but it has no function to perform. The brightener is not needed because the immersion-plated layer is subsequently over-coated with a much heavier layer deposited by one of the processes above. The brightener has no function because the immersion-plated layer essentially cannot be brightened. For these reasons, it would not have been obvious to add a brightener of any sort to an immersion plating composition, since there is no need or desire to improve the appearance of the resulting coating.

(7) It is my understanding that the claims of the present application have been rejected as obvious over the combination of U.S. Patent No. 2,580,773, to Heiman, with the above-mentioned Eckles patent, and that some of the dependent claims have been rejected over these references in combination with additional prior art references. I have carefully reviewed both the Heiman and Eckles patents. None of these patents are intended as a replenishment of alkaline zincate pretreatment prior to subsequent plating step. Both the processes are designed to prepare/produce a final metal finish layer on aluminum and aluminum alloys. Based on my review and understanding as a person of skill in the art, it would not have been in any way obvious or even suggested to combine the teachings of these patents as the USPTO Examiner has contended. The reason this would not have been obvious is that there is no reason one would add a brightener to an immersion plating composition. Despite the fact that Heiman says his bath could be converted to an electroplating bath, for the reasons discussed below, this

would not be done for a number of practical reasons and certainly does not in any way show "the equivalent use of zinc ion baths for immersion plating and electroplating purposes" as contended by the Examiner.

(8) Heiman teaches immersion plating of metals nobler than aluminum on aluminum substrates. Col. 2, lines 34-36. Heiman teaches that the metals to be deposited may include zinc, cadmium, tin, iron, nickel, cobalt or manganese, and certain alloys thereof. Col. 2, lines 39-40. Heiman teaches the use of fluoride ions. Col. 2, line 38. Heiman teaches that the bath contains hydrofluoric acid in a *minimum* concentration of 0.2 N. Col. 3, lines 70-71. Such a bath has a pH of less than 1. This is a highly acidic bath, and contains in excess of 100 times more acid than does the aqueous acidic immersion plating solution of the present invention. There is no reason a person would proceed to raise the pH as contended by the USPTO Examiner. To do so is not optimization; it is instead proceeding in direct conflict with the teachings of Heiman.

(9) As noted by the Examiner, Heiman teaches that, if thicker coatings are desired, the aluminum article may be connected as the cathode to a suitable source of direct current in a circuit to produce electrodeposits. However, there are a number of reasons why a skilled person would not attempt to deposit a coating by converting an immersion plating bath into an electroplating bath:

- Because immersion plating works by chemical displacement of metal ions in which the less noble metal is oxidized and dissolved in the plating solution and the more noble metal is reduced and deposited on the treated substrate, the immersion plating composition should be reactive to the substrate; otherwise the displacement reaction does not take place. Such a reactive composition is not a good choice for electroplating where the

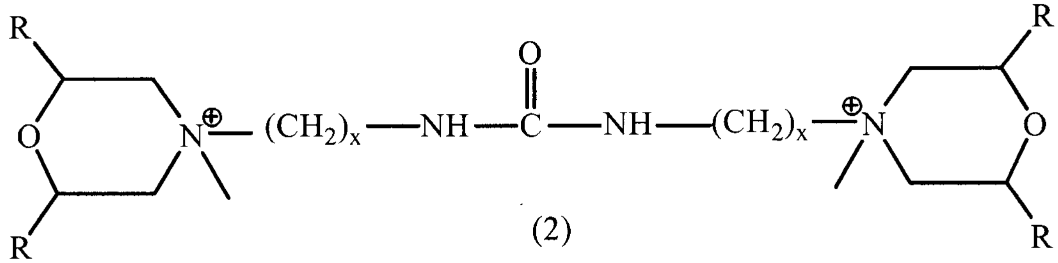
plated metal gets reduced by an externally applied electric current and there is no desire to remove any metal from the surface of the substrate.

- The physical properties of the metal deposited by an immersion plating composition are very poor, especially those from prior art compositions lacking inhibitors such as those disclosed and claimed. The process deposits a loose, spongy deposit with poor adhesion to the base substrate. We have discovered that the claimed inhibitors slow down the dissolution rate and help to deposit a relatively thinner deposit of finer crystal structure and also provide better adhesion to the base metal. Many of the compounds used in the present application as inhibitors are known to interfere in electroplating process.
- Unlike electroplating processes, immersion plating processes do not have any way to replenish the metal to be deposited. The concentration of the metal to be deposited decreases with time and simultaneously the bath accumulates the unwanted metal ions dissolved from the substrate by the reaction and the bath eventually stops plating. If the same chemistry is used under electroplating conditions, it is very likely that the external electric current will reduce the unwanted metal ions along with the preferred metal ions and produce undesired results. That is, for example, there would be deposited an alloy formed not of the desired nickel and zinc, but instead of aluminum, nickel and zinc. Such results would also vary unpredictably depending on time and bath composition.
- As there is no external source of metal ions, immersion plating baths always contain relatively higher concentration of metal salts to prevent premature depletion of metal ions and to get longer bath life. Such high concentrations of metal salts is not the best condition, from a practical point of view, for electroplating processes.

- On the other hand, most of the electroplating baths use anodes of the same metal as that which is to be deposited. The anode gets dissolved during the electrolytic plating process and the ions thus dissolved in the solution get deposited at the cathode (substrate to be plated). Electrolytic plating processes do not require the reactive chemistry as does immersion plating. As electrolytic processes do not dissolve the base substrate during the plating process, the adhesion of the deposited metal is always superior to that from the immersion processes.

For these reasons, persons of ordinary skill in the art do not consider that immersion plating is in any way equivalent to or interchangeable with electroplating. As is well known in the art, these two processes proceed by different mechanisms, use different chemistry, deposit qualitatively different coatings, deposit quantitatively different coatings, and the products are used for quite different purposes. Thus, even though Heiman teaches that his bath could be used for electroplating, it is highly unlikely that any person of ordinary skill in the art would do so and that is one of the reasons why we don't see such chemical composition in actual use in the plating industry, especially for the plating on aluminum.

(10) The Eckles reference teaches an electroplating bath for depositing a zinc alloy, which includes a quaternary ammonium polymer brightening agent, which may have the general formula (2) shown in Col. 2 of the Eckles patent, reproduced here:



(2)

While this compound is, technically, a nitrogen-containing heterocycle, it is not an inhibitor as defined in the present application and would not work as an inhibitor. This compound is disclosed by Eckles as a brightener and, as discussed above, it is positively charged and therefore would migrate to the cathode in an electroplating process. There is no disclosure in Eckles that would suggest that such a compound would be useful for any reason in an immersion plating composition such as that of the present invention. Moreover, inclusion of such brightener compounds in the immersion plating bath may interfere in the subsequent plating process, when the immersion plating process is intended for pretreatment prior to plating process, as in the present invention.

(11) Based on the foregoing facts, it is quite unlikely that any person of skill in the art, with the Heiman reference in hand, would look to the Eckles reference for any reason. It is highly unlikely that any person of skill in the art would find any reason or motivation to take the brightener used by Eckles and add this to the immersion plating composition taught by Heiman, for any reason. As stated above, there simply is no reason to do so.

(12) It is my understanding that the Examiner contended that, despite the fact that Heiman teaches that the acid content of the immersion plating bath must be at least 0.2 N in hydrofluoric acid, it would have been obvious for a person to increase the pH of the solution to the range that Eckles discloses for an electroplating bath, which is 3.5 to 6.2. This is clearly in error. As noted above, Heiman specifically states, at col. 3, lines 70-71: "The minimum hydrofluoric concentration is about 0.2 N." As stated above, such a bath has a pH of less than 1, and the 0.2 N is the minimum HF concentration, which concentration can go up to 2.5 N. This is a highly acidic bath, and contains in

excess of 100 times more acid than does the electroplating solution disclosed by Eckles. In view of the clear requirements of Heiman, and further in view of the fact that Eckles relates solely to an electroplating bath, there is no reason why any person would seek to increase the pH of Heiman's immersion plating bath to the range of 3.5 to 6.2 disclosed by Eckles for his electroplating bath. Therefore, it would not have been obvious to any person of ordinary skill in the art to have increased the pH of the Heiman immersion plating bath as suggested by the Examiner.

(13) It is noted that Heiman also teaches that zinc (not an alloy of zinc) could be deposited using fluoride salts instead of HF. However, since these salts are in solution with zinc sulfate, the pH would still be very low (since $ZnSO_4$ is a salt of a weak base and a strong acid).

(14) For all these reasons, it is my opinion as a person of skill in the art that no person of ordinary skill in the art would have found it obvious or in any way suggested or otherwise been motivated to employ in an immersion plating process a brightener disclosed only for use in an electroplating bath. *Brighteners are not used in immersion plating.* Immersion plating is used to prepare a surface for subsequent electroless plating and/or electroplating. Brighteners have no place in immersion plating, at least because the deposited layer is quite thin and because the deposited layer is subsequently over-plated with a much thicker layer of metal deposited by the aforementioned electroless plating and/or electroplating. For these reasons, the presently claimed invention would not have been obvious over the contended combination of Heiman and Eckles.

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I, Nayan H. Joshi, hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued therefrom.

Respectfully submitted,

10-26-06

Date

Nayan H. Joshi

Nayan H. Joshi

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